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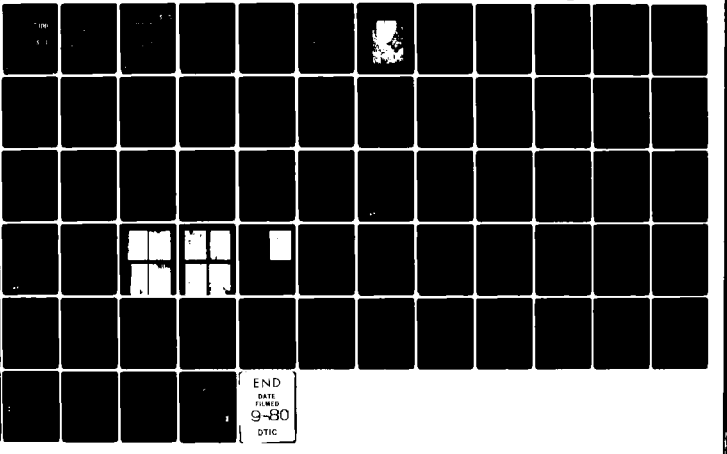

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SUSQUEHANNA RIVER BASIN

TRIBUTARY TO NORTH MAHANOY CREEK, SCHUYLKILL COUNTY

PENNSYLVANIA

MAHANOY DAM NO. 2

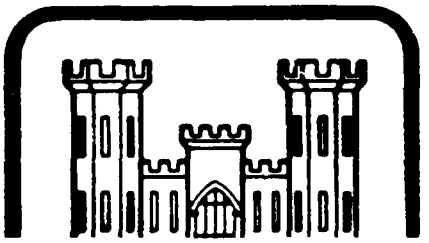
NDS ID NO. PA-667

DER ID NO. 54-11

HAZELTON MUNICIPAL WATER AUTHORITY

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM



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L. ROBERT KIMBALL & ASSOCIATES
DACW31-80-C-0020

Prepared By

L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS & ARCHITECTS
EBENSBURG, PENNSYLVANIA
15931

FOR

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT CORPS OF ENGINEERS
BALTIMORE, MARYLAND
21203

JUNE 1980

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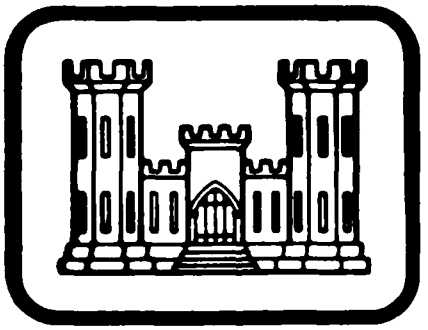

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PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in detemining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I REPORT
NATIONAL DAM INSPECTION REPORT

NAME OF DAM	Mahanoy Dam No. 2
STATE LOCATED	Pennsylvania
COUNTY LOCATED	Schuylkill
STREAM	Unnamed tributary North Mahanoy Creek
DATE OF INSPECTION	November 20, 1979

ASSESSMENT

The assessment of Mahanoy Dam No. 2 is based upon visual observations made at the time of inspection, review of available records and data, hydraulic and hydrologic computations and past operational performance.

Mahanoy Dam No. 2 appeared to be in poor condition. Vegetation consisting of brush and small trees were observed on the upstream and downstream slopes. Erosion was noted on the downstream embankment near the maximum section of the dam. Several wet areas were located on the downstream face of the embankment during the inspection. One seepage point was noted at the right abutment contact and two other seepage points were observed near the left abutment. The reservoir drain valves have not been operated in the recent past. Maintenance of the dam and operating facilities is considered poor.

Mahanoy Dam No. 2 is a high hazard-small size dam. The spillway design flood is the 1/2 PMF to PMF (Probable Maximum Flood). Based on the downstream potential for loss of life the spillway design flood for this dam has been selected as the PMF. Mahanoy Dam No. 2's spillway is capable of controlling approximately 12% of the PMF without overtopping the embankment. Based on criteria established by the Corps of Engineers, the spillway is termed seriously inadequate. If Mahanoy Dam No. 2 should fail due to overtopping, hazard to loss of life and property downstream of the dam would be significantly increased from that which would exist prior to the overtopping. Mahanoy Dam No. 2 is classified as unsafe, non-emergency.

The following recommendations and remedial measures should be instituted immediately.

1. A detailed hydrologic and hydraulic study should be conducted by a professional engineer knowledgeable in dam design and construction to increase the spillway capacity.

2. The wet and seepage areas should be monitored on a regular basis and after periods of heavy precipitation. The monitoring program and collected data should be evaluated by a professional engineer knowledgeable in dam design and analysis. Remedial measures should be conducted as required as a result of the evaluation.

3. Some means of positive upstream closure of the drainline should be developed in the case of emergencies.

4. The trees and brush located on the embankment slopes and in the spillway channel should be cleared at the direction of a professional engineer knowledgeable in dam design and construction.

5. A safety inspection program should be implemented with inspections at regular intervals by qualified personnel.

6. A warning system should be developed to warn downstream residents of large spillway discharges or imminent failure of the dam.

7. Erosion of the downtream slope should be repaired and measures taken to eliminate future erosion.

8. A review of mining activities should be conducted by the owner or his engineer to determine the effects of any past and present mining beneath the reservoir.

SUBMITTED BY:

L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS AND ARCHITECTS

COMMONWEALTH OF PENNSYLVANIA
Registered PROFESSIONAL
R. JEFFREY KIMBALL
ENGINEER
No. 20215 E

R. Jeffrey Kimball

Date

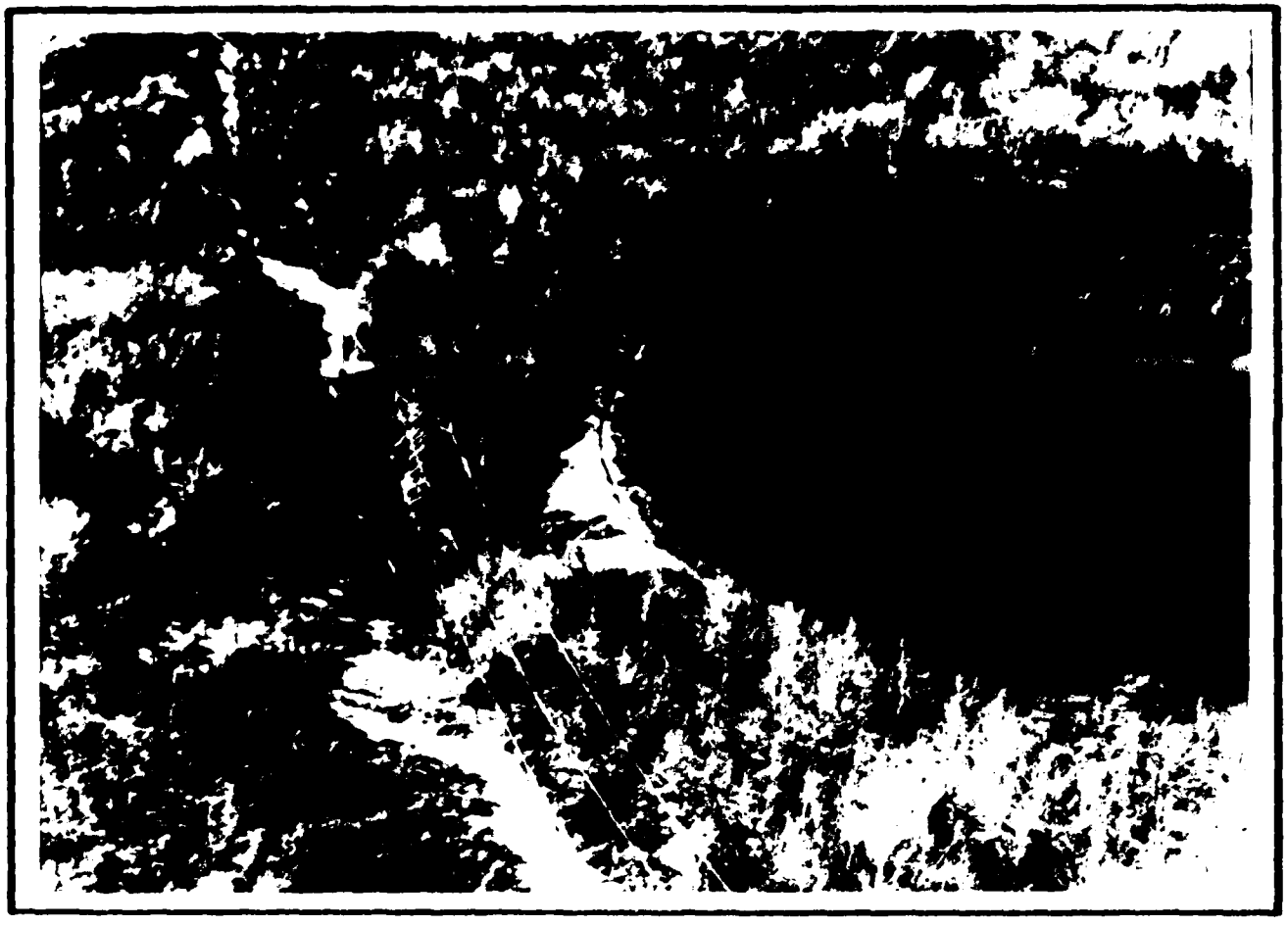
R. Jeffrey Kimball, P.E.

APPROVED BY:

11 July 1983

Date

JAMES W. PECK
Colonel, Corps of Engineers
District Engineer



Overview of Mahanoy Dam No. 2.

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APPENDICES

PHASE I
NATIONAL DAM INSPECTION PROGRAM
MAHANOY DAM NO. 2
NDI. I.D. NO. PA 667
DER I.D. NO. 54-11

SECTION 1
PROJECT INFORMATION

1.1 General.

a. Authority. The National Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspection of dams throughout the United States.

b. Purpose. The purpose of the inspection is to determine if the dam constitutes a hazard to human life or property.

1.2 Description of Project.

a. Dam and Appurtenances. Mahanoy Dam No. 2 is an earth-fill dam, 510 feet long and 35 feet high. The top width of the dam is 9 feet. The upstream slope of the dam is 3H:1V (submerged), and 1H:1V (above water). The downstream slope is 1.75H:1V.

One 18" pipe passes beneath the embankment to a 12 foot x 15 foot gate house. The gate house has been destroyed and only the foundation remains. The foundation is located 180 feet from the left abutment near the downstream toe of the embankment. A 12" service branch takes off from the 18" pipe, which is reduced to 10" in diameter immediately below the dam.

The spillway is cut through solid rock at the right abutment. It is flanked on the side adjacent to the embankment by a dry-laid masonry wall and on the opposite side by rock. The spillway is trapezoidal shaped and discharges into a natural stream below the dam.

b. Location. The dam is located on an unnamed tributary to North Mahanoy Creek, approximately 1/2 miles north of village of Parkplace, Schuylkill County, Pennsylvania. Mahanoy Dam No. 2 can be located on the Delano, U.S.G.S. 7.5 minute quadrangle.

c. Size Classification. Mahanoy Dam No. 2 is a small size dam (35 feet high, 44 acre-feet).

d. Hazard Classification. Mahanoy Dam No. 2 is a high hazard dam. Downstream conditions indicate that loss of more than a few lives is probable should the structure fail. The village of Parkplace is located 0.5 miles downstream of the dam.

e. Ownership. Mahanoy Dam No. 2 is owned by the Hazelton Municipal Water Authority. Correspondence should be addressed to:

Hazelton Municipal Water Authority
230-240 South Wyoming Street
Hazelton, PA 18201
Attention: Robert Zientek, Manager
(717) 454-2401

f. Purpose of Dam. Mahanoy Dam No. 2 is used for water supply.

g. Design and Construction History. Mahanoy Dam No. 2 was built in 1875. The dam was designed and construction supervised by Mr. Herbert S. Thompson, who was at the time engineer of the Gerard Water Company. Construction work was completed by Mr. Charles King, a Pottsville contractor.

h. Normal Operating Procedures. The reservoir level is maintained at or below the spillway crest elevation. The water supply line from the reservoir is always open. The excess inflow to the reservoir is discharged through the spillway at the right abutment.

1.3 Pertinent Data.

a. Drainage Area. 0.29 square miles

b. Discharge at Dam Site (cfs).

Maximum known flood at dam site	Unknown
Drainline capacity at normal pool	Unknown
Spillway capacity at top of dam	95

c. Elevation (U.S.G.S. Datum) (feet). - Based on spillway crest elevation 1744.0 supplied by Hazelton Municipal Water Authority.

Top of dam - low point	1746.1
Top of dam - design height	Unknown
Spillway crest	1744.0
Full flood control pool	N/A
Normal pool	1744.0

Upstream invert - 12" drainline	Unknown
Downstream invert - 12" drainline	Unknown
Streambed at centerline of dam	1711.0
Maximum tailwater	None
Toe of dam	1711.0

d. Reservoir (feet).

Length of maximum pool	600
Length of normal pool	550

e. Storage (acre-feet).

Normal pool	37
Top of dam	44

f. Reservoir Surface (acres).

Top of dam	3.5
Normal pool	3.03
Spillway crest	3.03

g. Dam.

Type	Earthfill
Length	510 feet
Height	35 feet
Top width	9 feet
Side slopes - upstream	1H:1V to 3H:1V
- downstream	1.75H:1V
Zoning	Unknown
Impervious core	Puddle core
Cutoff	Unknown
Grout curtain	Unknown

h. Reservoir Drain.

Type	12" CIP
Length	Unknown
Closure	Valve at toe
Access	Downstream end
Regulating facilities	Valve at toe

i. Spillway.

Type	Trapezoidal
Length	10 feet
Crest elevation	1744.0
Upstream channel	Lake
Downstream channel	Unnamed tributary to North Mahanoy Creek

SECTION 2
ENGINEERING DATA

2.1 Design. Review of information in the files of The Commonwealth of Pennsylvania, Department of Environmental Resources revealed that several inspection reports, some correspondence and photographs were available for review. No design data or construction drawings were contained in the files. The owner had very minimal data on the dam. The DER files were reviewed for this study.

2.2 Construction. No information is available on construction of the dam.

2.3 Operation. No operating records are maintained.

2.4 Evaluation.

a. Availability. Engineering data were provided by PennDER, Bureau of Dams and Waterways Management. The owner stated that no operation or maintenance had been conducted at the dam. The owner did not accompany the inspection team during the inspection.

b. Adequacy. There is no design data or other information available. The Phase I report is based on visual inspection and hydrologic and hydraulic analyses. Sufficient information is available to complete the Phase I report.

SECTION 3
VISUAL INSPECTION

3.1 Findings.

a. General. The onsite inspection of Mahanoy Dam No.2 was conducted by personnel of L. Robert Kimball and Associates on November 16 and 20, 1979. The inspection consisted of:

1. Visual inspection of the retaining structure, abutments and toe.
2. Examination of the spillway facilities, exposed portion of any outlet works and other appurtenant works.
3. Observations affecting the runoff potential of the drainage basin.
4. Evaluation of the downstream area hazard potential.

b. Dam. The dam appears to be in poor condition. From a brief survey conducted during the inspection, it was determined that the low spot on the crest of the embankment is located approximately 350 feet from the left abutment. The crest width is 9 feet. The upstream slope is 3H:1V (submerged), and 1H:1V above the reservoir water level. The downstream slope was measured to be 1.75H:1V. Extensive erosion was noted approximately 210 feet from the left abutment on the downstream slope of the dam near the maximum section. Several seepage points were located on the downstream slope of the embankment. One seepage point was at the right abutment contact and two points were located to the right of the old valve house foundation. Seepage from the left abutment is collected near the toe where a deteriorated weir was observed. Discharge through the weir was measured to be approximately 30 gallons per minute. The total seepage was measured at a point beyond the toe and across the road which parallels the embankment. The total seepage was measured to be approximately 90 gallons per minute. The seepage from the right abutment is therefore estimated to be approximately 60 gallons per minute.

c. Appurtenant Structures. The reservoir outlet works consists of an 18" cast iron pipe, which is reduced to 12" in diameter immediately below the dam, and then to 10" and finally to an 8" pipe before the village of Parkplace. Gate valves are installed on the main pipe (18" CIP) and on the 12" branch. The foundation of the 12 foot x 15 foot gatehouse is visible near the toe of the embankment. The valves were not operated during the inspection nor have they been operated for several years.

The spillway consists of an open cut located on the right abutment. The spillway is trapezoidal shaped and the bottom width of the spillway is 10 feet. The spillway exit channel consists of a natural stream which is an unnamed tributary to North Mahanoy Creek. Small trees and debris are located in the spillway and the spillway exit channel.

d. Reservoir Area. The watershed is covered mostly with timberland. The reservoir slopes are gentle and are not susceptible to massive landslides which would affect the storage volume of the reservoir or overtopping of the dam by displacing water.

e. Downstream Channel. The downstream channel of Mahanoy Dam No. 2 consists of an unnamed tributary to North Mahanoy Creek. The length of the channel is approximately 1/2 mile. The channel runs through the village of Parkplace where it eventually joins North Mahanoy Creek, which eventually flows through Mahanoy City.

3.2 Evaluation. In general, the embankment appears to be in fair condition. Based on evidence obtained from the visual inspection and from data obtained in the PennDER files, it appears that the top of dam has been raised and/or modified. The appurtenant structures appear to be in poor condition. The embankment and appurtenant structures are not maintained. The seepage areas located at either abutment of the dam should be monitored on a regular basis.

SECTION 4
OPERATIONAL PROCEDURES

4.1 Procedures. Water is drawn off the reservoir through the outlet works and supplies the village of Parkplace and other nearby communities. According to the owner the outlet works are not operated. The reservoir is maintained at the spillway crest elevation of 1644.0. The excess inflow discharges through the spillway at the right abutment.

4.2 Maintenance of the Dam. No planned maintenance schedule exists. Maintenance of the dam is non-existent according to the owner. Maintenance of the dam is considered poor.

4.3 Maintenance of Operating Facilities. The operating facilities are not maintained.

4.4 Warning System in Effect. There is no warning system in effect to warn downstream residents of large spillway discharges or imminent failure of the dam.

4.5 Evaluation. The condition of the dam and operating facilities is considered poor. There is no warning system in effect to warn downstream residents.

SECTION 5
HYDRAULICS AND HYDROLOGY

5.1 Evaluation of Features.

a. Design Data. No calculations or design data pertaining to hydrology were available.

b. Experience Data. No rainfall, runoff or reservoir level data were available. The spillway reportedly has functioned adequately in the past.

c. Visual Observations. The spillway appears to be in poor condition and poorly maintained. Brush and small trees growing in spillway and exit channel have been left unattended and debris is collecting in spillway channel.

A low spot was noted on the embankment approximately 350 feet from the left abutment.

d. Overtopping Potential. Overtopping potential was investigated through the development of the probable maximum flood (PMF) for the watershed and the subsequent routing of the PMF and fractions of the PMF through the reservoir and spillway.

The Corps of Engineers, Baltimore District, has directed that the HEC-1 Dam Safety Version systemized computer program be utilized. The program was prepared by the Hydrologic Engineering Center (HEC), U.S. Army Corps of Engineers, Davis, California, July, 1978. The major methodologies or key input data for this program are discussed briefly in Appendix D.

5.2 Evaluation Assumptions. To enable us to complete the hydraulic and hydrologic analysis for this structure, it was necessary to make the following assumptions.

1. A pool elevation of 1744.0' was assumed prior to the storm.

2. The low spot on the embankment (elevation 1746.1 feet) was considered the top of dam.

5.3 Summary of Overtopping Analysis. Complete summary sheets for the computer output are presented in Appendix D.

Peak inflow (PMF)	823 cfs
Spillway capacity	95 cfs

a. Spillway Adequacy Rating. The Spillway Design Flood (SDF) for this dam is the 1/2 PMF to the PMF. The SDF is based on the downstream potential for loss of life and has been selected as the PMF. Based on the following definition provided by the Corps of Engineers, the spillway is rated as seriously inadequate as a result of our hydrologic analysis.

> Seriously inadequate - High hazard classification dams not capable of passing 50% of the SDF and where there is a significant increase in the hazard potential for loss of life due to overtopping failure.

The spillway and reservoir are capable of controlling approximately 12% of the PMF without overtopping the dam (based on a low spot elevation on the main embankment). A computer printout of the hydrologic analyses is included in Appendix D.

5.4 Summary of Dam Breach Analysis. As the subject dam cannot satisfactorily pass 50% of the PMF (based on our analyses) it was necsessary to perform the dam breach analysis and downstream routing of the flood wave. This analysis determines the degree of flooding due to dam failure.

Due to the lack of vegetation on the crest and the visibily high sand content of the embankment, the water level in the reservoir at the time of dam failure was assumed to be at 1746.2 feet (0.12 feet over the top of dam, low spot). Based on the evaluating engineers judgement, the 20% PMF was routed through the reservoir and downstream.

The flood wave was routed downstream with and without embankment failure considered. The dam breach analysis parameters are included in Appendix D.

Results of the dam breach analysis indicate that the downstream flooding is significantly increased. Since flooding downstream is significantly increased due to dam failure, according to the Corps of Engineers definitions the spillway is rated as "seriously inadequate".

SECTION 6
STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability.

a. Visual Observations. No signs of slumping were noted during the inspection. The shape of the crest appears to verify information obtained from the DER file relative to additional material having been added to the top of dam at one point in time. The possibility exists that mining may have occurred in the area at some point in time although it is impossible to determine if subsidence was the reason the material was added to the crest. Based on observations made at the time of the inspection it appears that the dam is stable.

Erosion was noted on the downstream slope of the embankment near the maximum section. This erosion begins near the crest approximately 180 feet from the left abutment and continues vertically toward the toe of dam. Some brush was observed on the upstream slope of the embankment. Brush and small trees were evident on the downstream slope.

Several wet areas and seepage points were located on the embankment during the inspection near the left and right abutments. One seepage point was located at the right abutment contact and seepage was estimated at approximately 60 gallons per minute. Two other seepage points were observed to the right of the abandoned gate house. Seepage from the left abutment is collected near the toe and a wooden weir was observed for the purpose of measuring seepage at this point. The combined seepage was measured beyond the toe and across the roadway which parallels the embankment. This total seepage was measured to be approximately 90 gallons per minute. The seepage is discharged from the area through an open channel.

Review of seepage monitoring data contained in the PennDER files showed seasonal variations in the quantity of seepage. The measurements were obtained during a two year period beginning in July, 1930. A low value of approximately 13 GPM and high value of 101 GPM were measured during this period. There appears to be no mention of seepage from the right abutment. Placement of the weir, as observed during our inspection, was such that it could not have been used to measure seepage from the right abutment and therefore, it is our conclusion that seepage from the right abutment did not begin to occur until sometime after 1931. Seepage measurements made during our inspection somewhat agree with the measurements made during the 1930-1931 period for the month of November, but the deteriorated condition of the weir made an accurate measurement impossible.

b. Design and Construction Data. No design or construction data is available. No stability analyses have been conducted for this dam.

c. Operating Records. No operating records are maintained.

d. Post Construction Changes. Based on information obtained from the PennDER files, material has been added to the crest to raise the top of dam elevation. No date is associated with this construction.

e. Seismic Stability. The dam is located in seismic zone 1. No seismic stability analyses has been performed. Normally, it can be considered that if a dam in this zone is stable under static loading conditions, it can be assumed safe for any expected earthquake loading.

SECTION 7
ASSESSMENT AND RECOMMENDATIONS/REMEDIAL MEASURES

7.1 Dam Assessment.

a. Safety. The dam appears to be in poor condition but poorly maintained. A significant amount of seepage was evident at the right abutment contact and near the left abutment to the right of the abandoned gate house. In addition, past inspections reported a considerable amount of seepage. The visual observation, review of available data, hydrologic and hydraulic calculations and past operational performance indicate that the Mahanoy Dam No. 2's spillway is seriously inadequate. The spillway is capable of controlling approximately 12% of the PMF without overtopping the embankment. The hydrologic and hydraulic analyses indicates that flooding downstream of the dam would be significantly increased due to failure of the dam from that which would exist prior to dam failure. No adequate stability analysis have been performed for this structure. Mahanoy Dam No. 2 is classified as unsafe non-emergency.

Review of seepage monitoring data contained in the PennDER files showed seasonal variations in the quantity of seepage. The measurements were obtained during a two year period beginning in July, 1930. A low value of approximately 13 GPM and high value of 101 GPM were measured during this period. Their appears to be no mention of seepage from the right abutment. Placement of the weir, as observed during our inspection, was such that it could not have been used to measure seepage from the right abutment and therefore, it is our conclusion that sepage from the right abutment did not begin to occur until sometime after 1931. Seepage measurements made during our inspection somewhat agrees with the measurements made during the 1930-1931 period for the month of November but the detriorated condition of the weir made on accurate measurement impossible.

b. Adeqacy of Information. Sufficient information is available to complete a Phase I Report.

c. Urgency. The recommendations suggested below should be implemented immediately.

d. Necessity for Further Investigation. In order to accomplish some of the recommendations/remedial measures outlined below, further investigations will be required.

7.2 Recommendations/Remedial Measures.

1. A detailed hydrologic and hydraulic study should be conducted by a professional engineer knowledgeable in dam design and construction to increase the spillway capacity.

2. The wet and seepage areas should be monitored on a regular basis and after periods of heavy precipitation. The monitoring program and collected data should be evaluated by a professional engineer knowledgeable in dam design and analysis. Remedial measures should be conducted as required as a result of the evaluation.

3. Some means of positive upstream closure of the drainline should be developed in the case of emergencies.

4. The trees and brush located on the embankment slopes and in the spillway channel should be cleared at the direction of a professional engineer knowledgeable in dam design and construction.

5. A safety inspection program should be implemented with inspections at regular intervals by qualified personnel.

6. A warning system should be developed to warn downstream residents of large spillway discharges or imminent failure of the dam.

7. Erosion of the downtream slope should be repaired and measures taken to eliminate future erosion.

8. A review of mining activities should be conducted by the owner or his engineer to determine the effects of any past and present mining beneath the reservoir.

APPENDIX A
CHECKLIST, VISUAL INSPECTION, PHASE I

CHECK LIST
VISUAL INSPECTION
PHASE I

NAME OF DAM Mahanoy Dam No. 2 COUNTY Schuylkill STATE Pennsylvania ID# PA 667

TYPE OF DAM Earthfill HAZARD CATEGORY High

DATE(s) INSPECTION November 7 and 16, 1979 WEATHER Cloudy, warm TEMPERATURE 50°

POOL ELEVATION AT TIME OF INSPECTION 1744.0 M.S.L. TAILWATER AT TIME OF INSPECTION None M.S.L.

A-1

INSPECTION PERSONNEL:

R. Jeffrey Kimball, P.E. - L. Robert Kimball and Associates

James T. Hockensmith - L. Robert Kimball and Associates

O.T. McConnell - L. Robert Kimball and Associates

O.T. McConnell
RECORDER

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None noted.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None noted.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Crest of dam and portions of the downstream slope at the maximum section show some erosion. The crest is concave in shape. No vegetation exists on the crest of the dam.	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Horizontal alignment appears to be good. Low spot on crest approximately 180 feet left of the right abutment.	
RIPRAP FAILURES	None noted.	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
VEGETATION	Brush on the upstream slope, brush and small trees on the downstream slope. Small trees growing on in the spillway discharge channel.	
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Abutment spillway in dam appears to be good.	
ANY NOTICEABLE SEEPACE	Several wet areas were located on the downstream embankment face. One area located at the right abutment contact. Two seepage points noted at the right of the old valve house. Total seepage estimated at approximately 90 gallons per minute.	
STAFF GAUGE AND RECORDER	None.	
DRAINS	None observed.	

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
ANY NOTICEABLE SEEPAGE	Not applicable.	
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	Not applicable.	
DRAINS	Not applicable.	
WATER PASSAGES	Not applicable.	
FOUNDATION	Not applicable.	

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	Not applicable.	
STRUCTURAL CRACKING	Not applicable.	
VERTICAL AND HORIZONTAL ALIGNMENT	Not applicable.	
MONOLITH JOINTS	Not applicable.	
CONSTRUCTION JOINTS	Not applicable.	
STAFF GAUGE OR RECORDER	Not applicable.	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	Not applicable.	
INTAKE STRUCTURE	Unobserved during inspection.	
OUTLET STRUCTURE	None.	
OUTLET CHANNEL	None.	
EMERGENCY GATE	Valve on outlet works at toe of dam.	

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	None.	
APPROACH CHANNEL	Lake.	
DISCHARGE CHANNEL	Natural stream which discharges beyond the toe of dam.	
BRIDGE AND PIERS	None.	

GATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	Not applicable.	
APPROACH CHANNEL	Not applicable.	
DISCHARGE CHANNEL	Not applicable.	
BRIDGE AND PIERS	Not applicable.	
GATES AND OPERATION EQUIPMENT	Not applicable.	

DOWNSTREAM CHANNEL

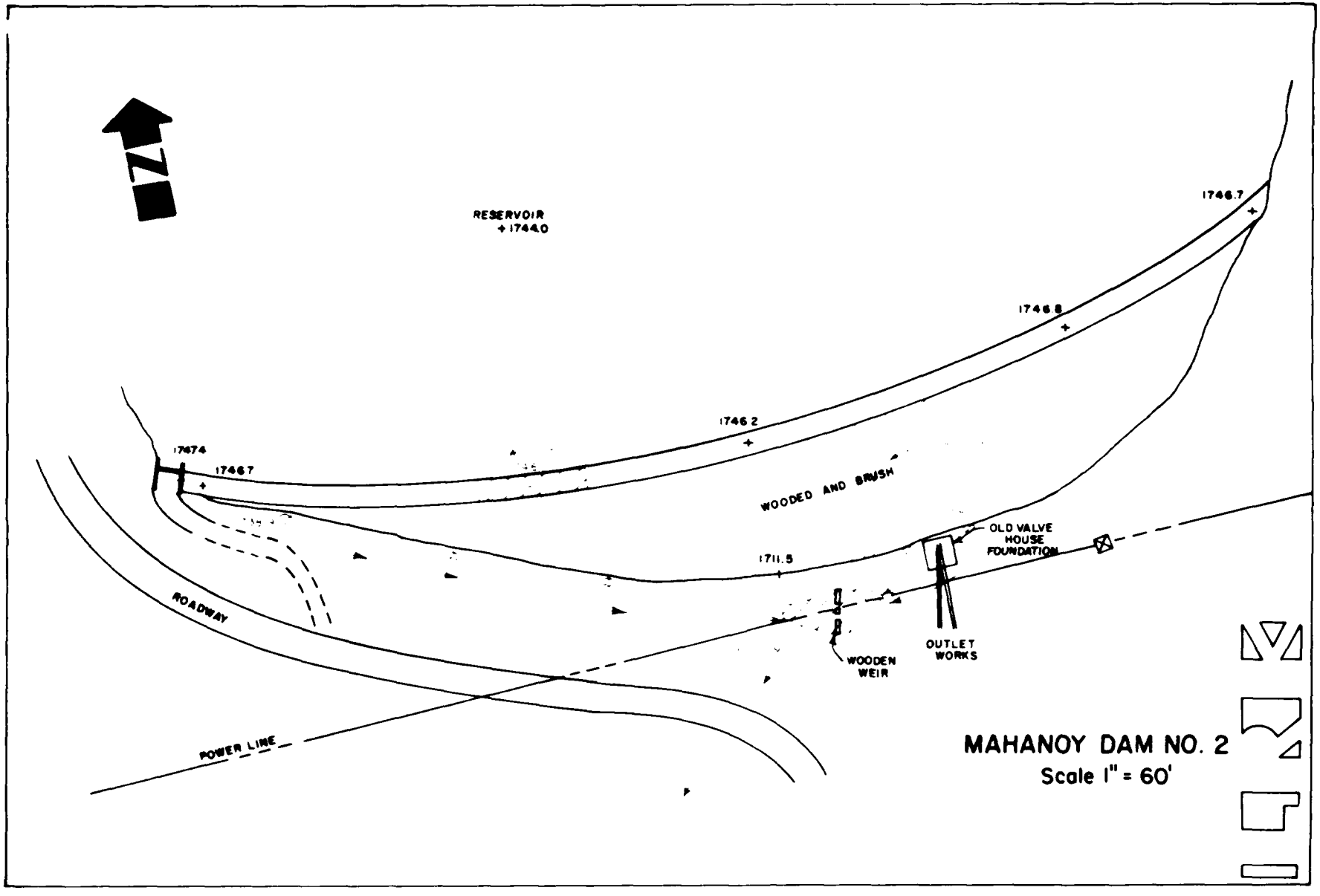
VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Vegetation and debris beginning to collect in the channel.	
SLOPES	Appear to be stable.	
APPROXIMATE NO. OF HOMES AND POPULATION	Village of Parkplace is located one-half mile downstream of the dam. Approximately 100 people.	

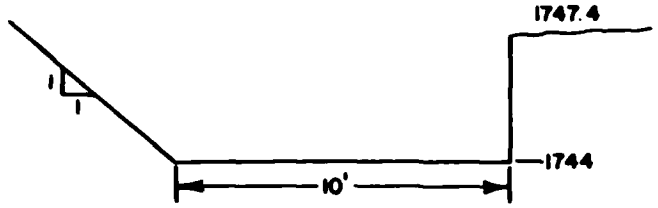
RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Moderate to steep but appear to be stable.	
SEDIMENTATION	Does not appear to be excessive.	

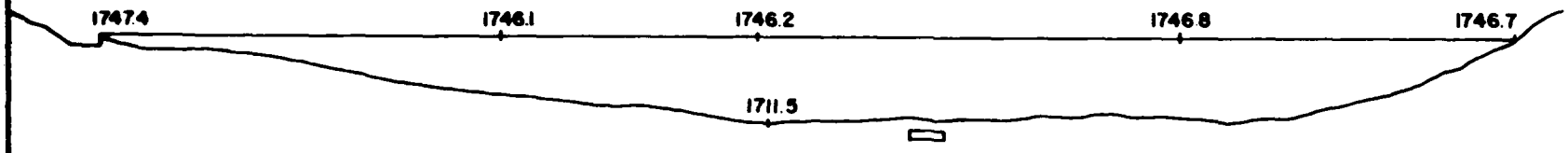
INSTRUMENTATION

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None.	
OBSERVATION WELLS	None.	
WEIRS	Weir at toe of embankment collecting seepage from seepage points to the right of the abandoned valve house. Condition of the weir is deteriorating. The weir should be repaired. The present weir does not collect seepage from the right abutment.	
PIEZOMETERS	None.	
OTHER	None.	


N
RESERVOIR
+1744.0
1746.7
1746.8
1746.2
1747.4
1746.7
WOODED AND BRUSH
1711.5
OLD VALVE
HOUSE
FOUNDATION
OUTLET
WORKS
WOODEN
WEIR
ROADWAY
POWER LINE
MAHANOY DAM NO. 2
Scale 1" = 60'



SPILLWAY PROFILE
(Not to Scale)



PROFILE
LOOKING UPSTREAM
(Scale 1"=60')

MAHANOY DAM, NO. 2

APPENDIX B
CHECKLIST, ENGINEERING DATA, DESIGN, CONSTRUCTION, OPERATION, PHASE I

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM ~~Mahanoy Dam No. 2~~

ID# ~~PA 667~~

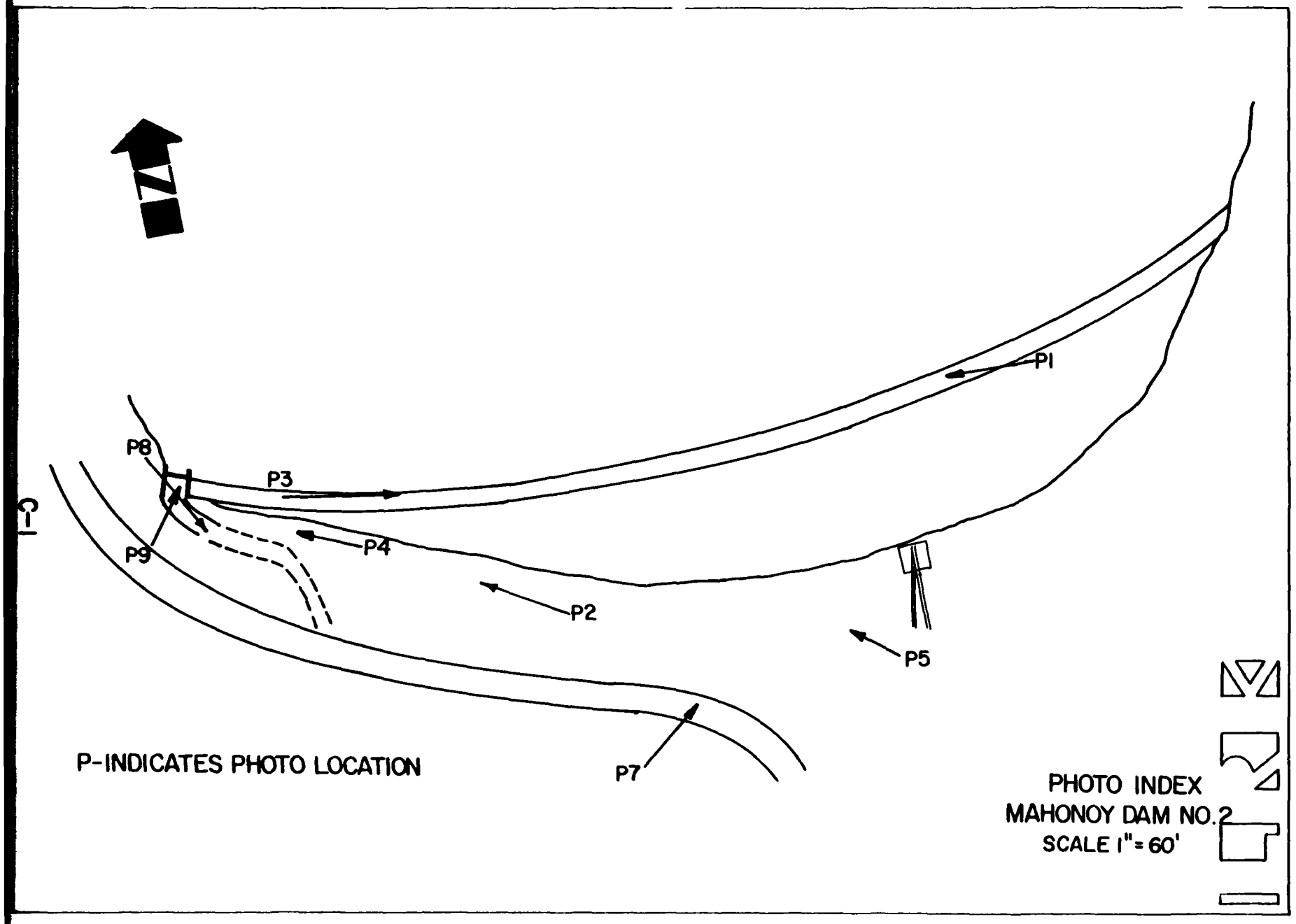
ITEM	REMARKS
AS-BUILT DRAWINGS	None.
REGIONAL VICINITY MAP	U.S.G.S. quadrangle.
CONSTRUCTION HISTORY	None.
TYPICAL SECTIONS OF DAM	None.
OUTLETS - PLAN - DETAILS - CONSTRAINTS - DISCHARGE RATINGS RAINFALL/RESERVOIR RECORDS	None. None. None. None. None.

ITEM	REMARKS
DESIGN REPORTS	None.
GEOLOGY REPORTS	None.
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	Hydrology and hydraulics.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	Seepage measurements were made during the years 1930 and 1931. Monthly seepage reports during this period were made to PennDER.
POST-CONSTRUCTION SURVEYS OF DAM	Unknown.
BORROW SOURCES	Unknown.

ITEM	REMARKS
MONITORING SYSTEMS	None.
MODIFICATIONS	Embankment crest raised.
HIGH POOL RECORDS	None.
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	Unknown.
MAINTENANCE OPERATION RECORDS	None.

ITEM	REMARKS
SPILLWAY PLAN SECTIONS DETAILS	Hand drawn details in PennDER files.
OPERATING EQUIPMENT PLANS & DETAILS	None.

APPENDIX C
PHOTOGRAPHS


N
P1
P2
P3
P4
P5
P7
P8
P9
P-INDICATES PHOTO LOCATION
PHOTO INDEX
MAHONOY DAM NO. 2
SCALE 1" = 60'

MAHANOY DAM NO. 2

Photograph Descriptions

Sheet 1. Front

(1) Upper left - Upstream slope and crest looking toward right abutment.
(2) Upper right - Downstream slope of dam with seepage at toe.
(3) Lower left - Upstream slope of dam looking toward left abutment.
(4) Lower right - Donwstream slope of dam.

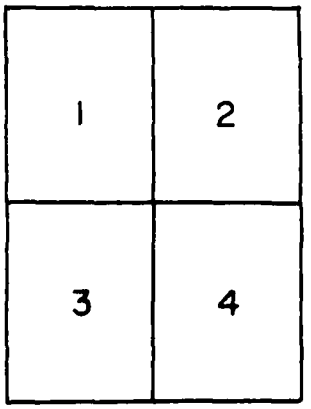
Sheet 1. Back

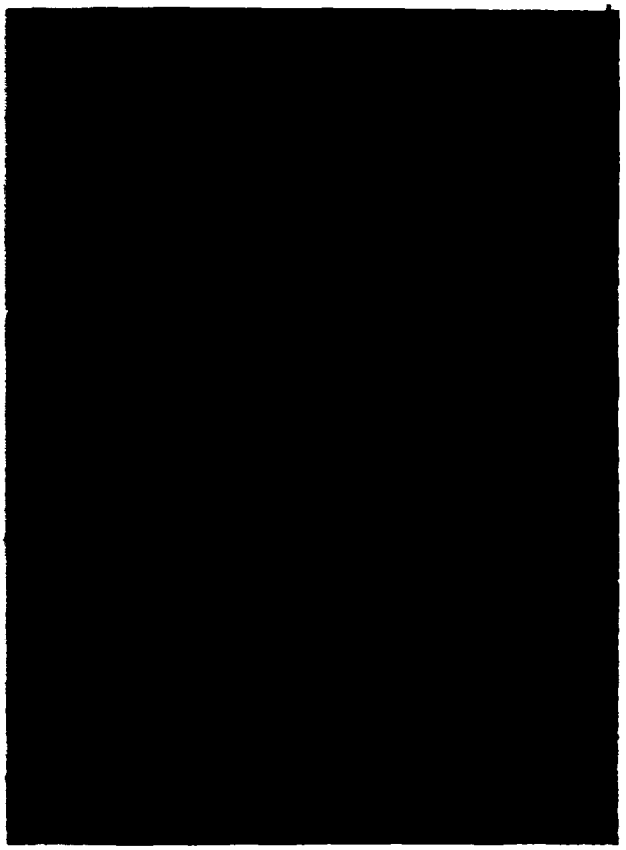
(5) Upper left - Seepage measuring weir.
(6) Upper right - Upstream slope of dam and downstream exposure.
(7) Lower left - Downstream slope of dam. Seepage weir in lower left corner.
(8) Lower right - Spillway.

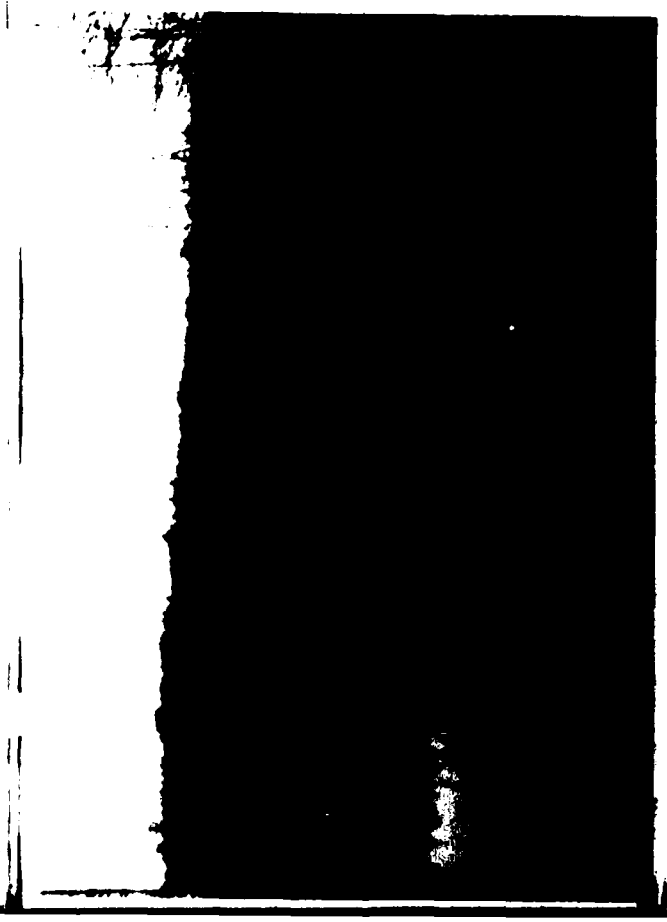
Sheet 2. Front

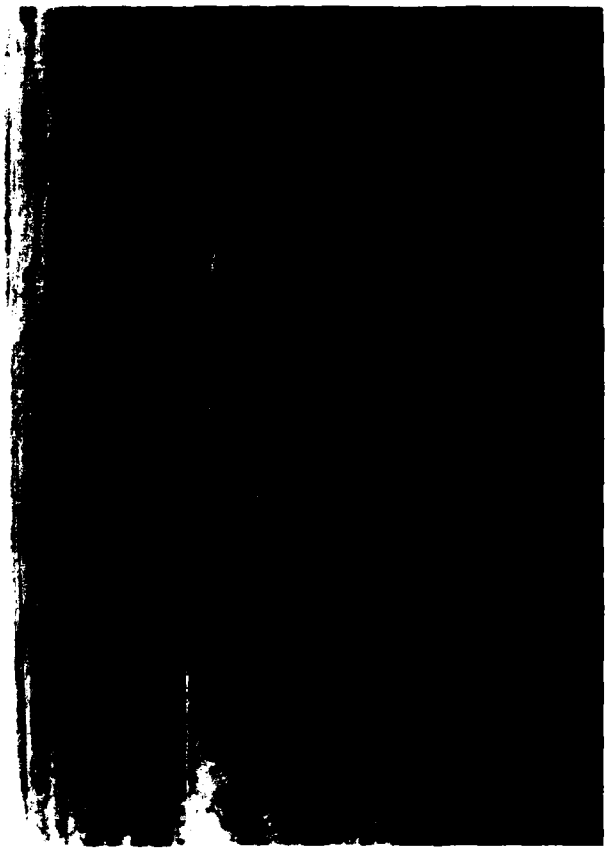
(9) Upper right - Spillway weir (deteriorated).

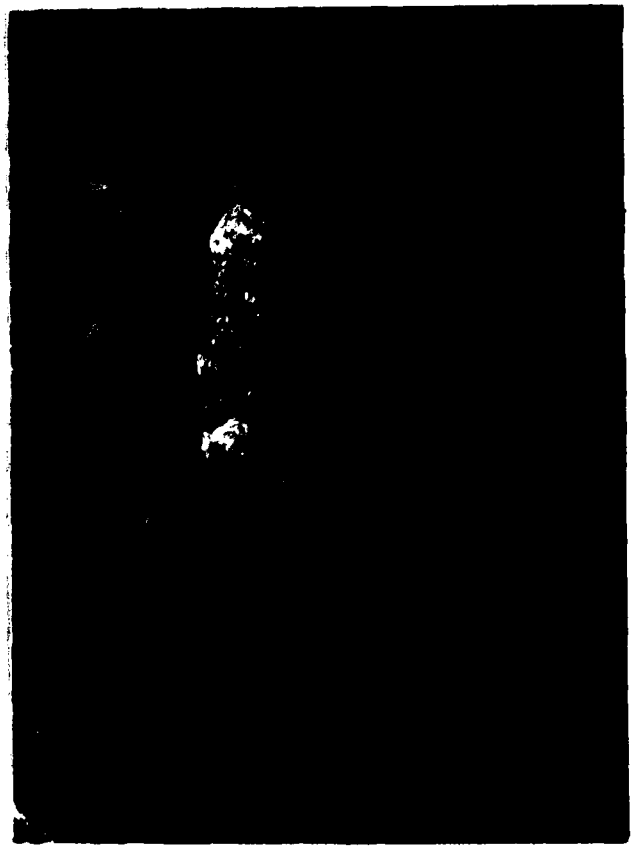
TOP OF PAGE











APPENDIX D
HYDROLOGY AND HYDRAULICS

APPENDIX D
HYDROLOGY AND HYDRAULICS

Methodology. The dam overtopping and breach analyses were accomplished using the systemized computer program HEC-1 (Dam Safety Investigation), September, 1978, prepared by the Hydrologic Engineering Center, U.S. Army Corps of Engineers, Davis, California. A brief description of the methodology used in the analysis is presented below.

1. Precipitation. The Probable Maximum Precipitation (PMP) is derived and determined from regional charts prepared from past rainfall records including "Hydrometeorological Report No. 40" prepared by the U.S. Weather Bureau.

The index rainfall is reduced from 10% to 20% depending on watershed size by utilization of what is termed the HOP Brook adjustment factor. Distribution of the total rainfall is made by the computer program using distribution methods developed by the Corps.

2. Inflow Hydrograph. The hydrologic analysis used in development of the overtopping potential is based on applying a hypothetical storm to a unit hydrograph to obtain the inflow hydrograph for reservoir routing.

The unit hydrograph is developed using the Snyder method. This method requires calculation of several key parameters. The following list gives these parameters their definition and how they were obtained for these analysis.

Parameter	Definition	Where Obtained
Ct	Coefficient representing variations of watershed	From Corps of Engineers*
L	Length of main stream channel miles	From U.S.G.S. 7.5 minute topgraphic
Lca	Length on main stream to centroid of watershed	From U.S.G.S. 7.5 minute topographic
Cp	Peaking coefficient	From Corps of Engineers*
A	Watershed size	From U.S.G.S. 7.5 minute topographic

*Developed by the Corps of Engineers on a regional basis for Pennsylvania.

3. Routing. Reservoir routing is accomplished by using Modified Plus routing techniques where the flood hydrograph is routed through reservoir storage. Hydraulic capacities of the outlet works, spillways and the crest of the dam are used as outlet controls in the routing.

The hydraulic capacity of the outlet works can either be calculated and input or sufficient dimensions input and the program will calculate an elevation discharge relationship.

Storage in the pool area is defined by an area - elevation relationship from which the computer calculates storage. Surface areas are either planimetered from available mapping or U.S.G.S. 7.5 minute series topographic maps or taken from reasonably accurate design data.

4. Dam Overtopping. Using given percentages of the PMF the computer program will calculate the percentage of the PMF which can be controlled by the reservoir and spillway without the dam overtopping.

5. Dam Breach and Downstream Routing. The computer program is equipped to determine the increase in downstream flooding due to failure of the dam caused by overtopping. This is accomplished by routing both the pre-failure peak flow and the peak flow through the breach (calculated by the computer with given input assumptions) at a given point in time and determining the water depth in the downstream channel. Channel cross-sections taken from U.S.G.S. 7.5 minute topographic maps were used in the downstream flood wave routing. Pre and post failure water depths are calculated at locations where cross-sections are input.

HYDROLOGY AND HYDRAULICS ANALYSIS
DATA BASE

NAME OF DAM: Mahanoy Dam No. 2

PROBABLE MAXIMUM PRECIPITATION (PMP) = 22.2 (1.00) = 22.2 inches

STATION	1	2	3
Station Description	Mahanoy Dam No. 2		
Drainage Area (square miles)	0.29		
Cumulative Drainage Area (square miles)	0.29		
Adjustment of PMF for Drainage Area (%)(1)			
6 hours	117		
12 hours	127		
24 hours	136		
48 hours	143		
72 hours	145		
Snyder Hydrograph Parameters			
Zone (2)	13		
Cp (3)	0.5		
Ct (3)	1.85		
L (miles) (4)	0.85		
Lca (miles) (4)	0.38		
tp = Ct(LxLca) $^{0.3}$ hrs.	1.32		
Spillway Data			
Crest Length (ft)	10'		
Freeboard (ft)	2.1		
Discharge Coefficient	C' = 0.95		
Exponent	N/A		

(1) Hydrometeorological Report 40 (Figure 1), U.S. Army Corps of Engineers, 1965.
(2) Hydrological zone defined by Corps of Engineers, Baltimore District, for determining Snyder's coefficients (C_p and C_t).
(3) Snyder's Coefficients.
(4) L=Length of longest water course from outlet to basin divide. L_{ca}=Length of water course from outlet to point opposite the centroid of drainage area.

CHECK LIST
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 0.29 square mi

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 37 ac-ft

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): 44 ac-ft

ELEVATION MAXIMUM DESIGN POOL: Unknown

ELEVATION TOP DAM: 1746.1 feet

SPILLWAY CREST:

a. Elevation 1744.0 feet
b. Type Trapezoidal
c. Width 10 feet
d. Length Unknown
e. Location Spillover Right abutment
f. Number and Type of Gates None

OUTLET WORKS:

a. Type 18" CIP reduces 12" CIP
b. Location ~~Maximum section~~
c. Entrance inverts Unknown
d. Exit inverts Unknown
e. Emergency draindown facilities 12" CIP

HYDROMETEOROLOGICAL GAUGES:

a. Type None
b. Location ~~None~~
c. Records None

MAXIMUM NON-DAMAGING DISCHARGE: Unknown

L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS & ARCHITECTS
EBENSBURG PENNSYLVANIA

DAM NAME MAHANOY DAM NO. 2
I.D. NUMBER 667
SHEET NO. 1 OF 4
BY MAB DATE 4-17-80

LOSS RATE AND BASE FLOW PARAMETERS

AS RECOMMENDED BY CORPS OF ENGINEERS BALTIMORE DISTRICT.

STRTL = 1 INCH

CNSTL = .05 IN/HR

STRTQ = 1.5 CFS/MI^2

QRCSN = .05 (5% OF PEAK FLOW)

RTIOR = 2.0

ELEVATION - AREA - CAPACITY RELATIONSHIPS

FROM USGS 7.5 MIN QUAD., DER FILES AND FIELD INSPECTION DATA.

SPILLWAY CREST ELEV. = 1744'
INITIAL STORAGE = 36.7 AC-FT
POND SURFACE AREA = 3.06 AC

ELEVATION WHERE AREA EQUALS ZERO AS DETERMINED BY THE CONIC METHOD FOR RESERVOIR VOLUME

$H = 3V/A$
$= 3(36.7)/3.06$
$= 36'$

$1744 - 36 = 1708$

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CONSULTING ENGINEERS & ARCHITECTS
EBENSBURG PENNSYLVANIA

DAM NAME MAHANOY DAM NO 2
I.D. NUMBER 667
SHEET NO. 2 OF 4
BY CAB DATE 4-17-80

AT ELEV. 1760' AREA EQUAL 7.81 ac

AT ELEV. 1780' AREA EQUAL 16.99 ac

AREA	$A	0	3.06	7.81	16.99
ELEV.	$E	1708	1744	1760	1780

OVERTOP PARAMETERS

TOP OF DAM ELEV. (LOW SPOT) = 1746.1'
LENGTH OF DAM (EXCLUDING SPILLWAY) = 510'
COEFFICIENT OF DISCHARGE = 3.1

DISCHARGE RATING CURVE

TRAPEZOIDAL FLOW FROM:

$$Q = 8.03\, C' h_v^{1/2} (h_p - h_v)\left[B + z(h_p - h_v)\right]$$

$$h_v = \frac{3(2zh_p + B) - \left(16z^2h_p^2 + 16zBh_p + 9B^2\right)^{1/2}}{10z}$$

$B = 10 \qquad z = .5 \qquad C' = .95$

WEIR FLOW FROM:

$$Q = CLh^{1.5}$$

$C = 3.1 \qquad L = 12.1$

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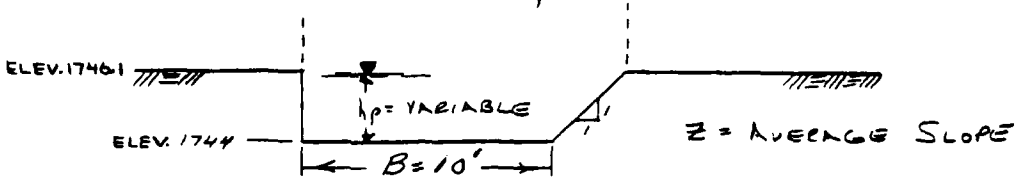
CONSULTING ENGINEERS & ARCHITECTS
EBENSBURG PENNSYLVANIA

DAM NAME MAHANOY DAM NO 2
I.D. NUMBER 667
SHEET NO. 3 OF 4
BY CAB DATE 4-17-80

TRAPEZOIDAL SPILLWAY
(NOT TO SCALE)



	TRAPEZOIDAL		WEIR		
ELEV.	h_p (ft)	Q^* (cfs)	h_p (ft)	Q^* (cfs)	Q^*_{TOTAL} (cfs)
1744	0	0			0
1744.5	.5	10			10
1745	1.0	30			30
1745.5	1.5	55			55
1746.1	2.1	95			95
1746.5			.4	10	105
1747			.9	30	125
1748			1.9	100	195
1750			3.9	290	385
1752.1			6.0	550	645

* VALUES ROUNDED TO NEAREST 5CFS

TRAPEZOIDAL FLOW FORMULA FROM:

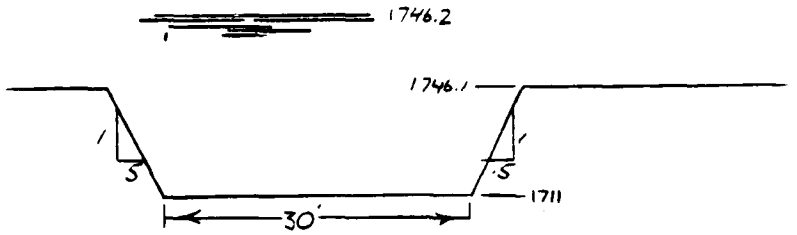
WATER AND WASTEWATER ENGNEERING (11-14) & (11-15)
BY: FAIR, GEYER & OKUM 1966

LOW DAMS
BY: NATIONAL RESOURCES COMMITTEE (eq. 7 & 8)
WASHINGTON, D.C. 1938

L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS & ARCHITECTS
EBENSBURG PENNSYLVANIA

DAM NAME MAHANOY DAM NO 2
I.D. NUMBER 667
SHEET NO. 4 OF 4
BY CAB DATE 4-28-80

DAM BREACH PARAMETERS



RATIO OF PMF (RTIO) = 0.2
SIDE SLOPE OF BREACH (Z) = .5
FAILURE TIME (TFAIL) = 2 HRS.
BOTTOM OF BREACH (BRWID) = 30'
BOTTOM ELEV. (ELBM) = 1711
FAILURE ELEV. (FAILEL) = 1746.2, 1750.0
INITIAL WATER ELEV. (WSEL) = 1744.0

$B	30	.5	1711	2	1744.0	1746.2
$B	30	.5	1711	2	1744.0	1750.0

CHANNEL ROUTING

CROSS SECTIONS OBTAINED FROM U.S.G.S. 7.5 MIN QUAD.
CHANNEL MANNING'S n = .05
OVERBANK MANNING'S n = .06

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION  JULY 1978
  EAST MODIFICATION  26 FEB 79
**********
    1          AI        ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMF
    2          A2      HYDROLOGIC-HYDRAULIC ANALYSIS OF MAHANOY DAM NO.2 (667)
    3          A3           RATIOS OF PMF ROUTED THROUGH THE RESERVOIR
    4          B    288      0      15       0       0       0       0       0       0       0
    5          B1     5
    6          J      1      4       1
    7          J1    .1     .2      .3       1
    8          K      0      1                                       1
    9          K1       INFLOW TO RESERVOIR
   10          M      1      1     .29                                                       1
   11          P            22.2     117     127     131     143     145
   12          T                                                   1.0     .05
   13          W    1.32     15
   14          X   -1.5    -.05     2.0
   15          R      1      2                                       1
   16          K1       ROUTE THRU RESERVOIR
   17          Y                                       1       1
   18          Y1     1                                                -1744      -1
   19          Y4  1746  1746.5    1745  1745.5  1746.1  1746.5    1747    1748    1750  1752.1
   20          Y5     0      10      30      55      95     105     125     195     385     645
   21          SA     0    3.06    7.81   16.99
   22          SE  1708    1744    1760    1780
   23          SS  1744
   24          SD1746.1     3.1     1.5     510
   25          K     99
```

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  26 FEB 79
**********

RUN  DATE= 80/04/17.
     TIME= 13.23.59.
```

ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMF
HYDROLOGIC-HYDRAULIC ANALYSIS OF MAHANOY DAM NO.2 (667)
RATIOS OF PMF ROUTED THROUGH THE RESERVOIR

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
288	0	19	0	0	0	0	0	0	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 4 LRTIO= 1

RTIOS= .10 .20 .30 1.00

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

INFLOW TO RESERVOIR

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	.29	0.00	.29	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	22.20	117.00	127.00	131.00	143.00	145.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH [\
TP= 1.32 CP= .50 ITA= 0

RECESSION DATA
STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00
APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 5.80 AND R= 7.12 INTERVALS

UNIT HYDROGRAPH 41 END-OF-PERIOD ORDINATES, LAG= 1.32 HOURS, CP= .50 VOL= 1.00

5.	18.	37.	55.	68.	75.	65.	56.	49.	43.
37.	32.	28.	24.	21.	18.	16.	14.	12.	10.
9.	8.	7.	6.	5.	4.	4.	3.	3.	3.
2.	2.	2.	1.	1.	1.	1.	1.	1.	1.
1.									

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

ROUTE THRU RESERVOIR

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
2	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-1744.	-1

STAGE	1744.00	1744.50	1745.00	1745.50	1746.10	1746.50	1747.00	1748.00	1750.00
//1752.10									
FLOW	0.00	10.00	30.00	55.00	90.00	105.00	125.00	195.00	385.00

//1649.00

SURFACE AREA=	0.	3.	8.	17.
CAPACITY=	0.	37.	121.	363.
ELEVATION=	1708.	1744.	1760.	1780.

CREL	SPWID	COOW	EXPW	ELEVL	COOL	CAREA	EXPL
1744.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COOD	EXPD	DAMWID

4 of 13

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 .10	RATIO 2 .20	RATIO 3 .30	RATIO 4 1.00
HYDROGRAPH AT	1	.29	1	82.	165.	247.	823.
		.751		2.331	4.661	6.991	23.301
ROUTED TO	2	.29	1	73.	163.	245.	821.
		.751		2.081	4.611	6.951	23.261

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1		INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
	ELEVATION	1744.00	1744.00	1746.10
	STORAGE	37.	37.	44.
	OUTFLOW	0.	0.	95.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.10	1745.78	0.00	43.	73.	0.00	41.75	0.00
.20	1746.22	.12	44.	163.	3.00	41.00	0.00
.30	1746.30	.20	44.	245.	4.75	41.00	0.00
1.00	1746.69	.59	46.	821.	8.75	41.00	0.00

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION     JULY 1978
  LAST MODIFICATION  26 FEB 79
**********
     1              AI       RATIOS OF PMF ROUTED THROUGH THE RESERVOIR AND DOWNSTREAM
     2              A2       DOWNSTREAM CONDITION DUE TO OVERTOPPING (MAHANOY DAM NO. 2 (66711
     3              A3       PLAN 1 ASSUMES BREACH, PLAN 2 ASSUMES NO BREACH
     4              B     288      0      15       0       0       0       0       0       0       0
     5              B1      5
     6              J       2      1       1
     7              J1     .2
     8              K       0      1                                              1
     9              K1             INFLOW TO RESERVOIR
    10              M       1      1      .29                                                      1
    11              P              22.2    117     127     131     143     145
    12              T                                                      1.0     .05
    13              W    1632     .5
    14              X    4169    4.05     210
    15              K       1      2                                              1
    16              K1             ROUTE THRU RESERVOIR
    17              Y                                      1       1
    18              Y1      1                                                -1744     -1
    19              Y6   1744   1744.5    1749   1745.9   1748.1   1748.5    1747    1748    1790    1752.1
    20              Y5      0      10      30      55      95      105     125     195     385     648
    21              SA      0   3.06    7.81   16.99
    22              SE   1708    1744    1760    1780
    23              SS   1744
    24              SD1746.1     3.1     1.5     510
    25              SB     30     .5    1711       2   1744.0   1748.2
    26              SB     30     .5    1711       2   1744.0   1750.0
    27              K       1      3                                              1
    28              K1             CHANNEL ROUTING = MOD PULS REACH NO. 1
    29              Y                                      1       1
    30              Y1      1
    31              Y6  .0306    0.05    0.06    1638    1660     800  0.0088
    32              Y7      0    1660      75    1650     150    1640     152    1638     194    1638
    33              Y7    156    1640     300    1650     350    1660
    36              K      99
```

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION     JULY 1978
  LAST MODIFICATION  26 FEB 79
**********

RUN  DATE= 80/04/17.
     TIME= 13.23.39.
```

RATIOS OF PMF ROUTED THROUGH THE RESERVOIR AND DOWNSTREAM
DOWNSTREAM CONDITION DUE TO OVERTOPPING (MAHANOY DAM NO. 2 (667))
PLANS 1 AND 2 ASSUMES BREACH. PLAN 3 ASSUMES NO BREACH

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
288	0	15	0	0	0	0	0	0	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 2 NRTIO= 1 LRTIO= 1

RTIOS= .20

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

INFLOW TO RESERVOIR

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	.29	0.00	.29	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	22.20	117.00	127.00	131.00	143.00	145.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA
TP= 1.32 CP= .50 NTA= 0

RECESSION DATA
STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00
APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 5.80 AND R= 7.12 INTERVALS

UNIT HYDROGRAPH 41 END-OF-PERIOD ORDINATES, LAG= 1.32 HOURS, CP= .50 VOL= 1.00

5.	18.	37.	55.	68.	71.	65.	56.	49.	43.
37.	32.	28.	24.	21.	18.	16.	14.	12.	10.
9.	8.	7.	6.	5.	4.	4.	3.	3.	3.
2.	2.	2.	1.	1.	1.	1.	1.	1.	1.
1.									

HYDROGRAPH ROUTING

ROUTE THRU RESERVOIR

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
2	1	0	0	0	0	1	0	0

ALL PLANS HAVE SAME ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-1744.	-1

STAGE	1744.00	1744.50	1745.00	1745.50	1746.10	1746.50	1747.00	1748.00	1750.00
//1752.10									
FLOW	0.00	10.00	30.00	55.00	95.00	105.00	125.00	195.00	385.00

845.00

SURFACE AREA=	0.	3.	8.	17.
CAPACITY=	0.	37.	121.	363.
ELEVATION=	1708.	1744.	1760.	1780.

CREL	SPWID	COOW	EXPW	ELEVL	COOL	CAREA	EXPL
1744.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
1746.1	3.1	1.5	510.

DAM BREACH DATA

BRWID	Z	ELBM	TFAIL	WSEL	FAILEL
30.	.50	1711.00	2.00	1744.00	1746.20

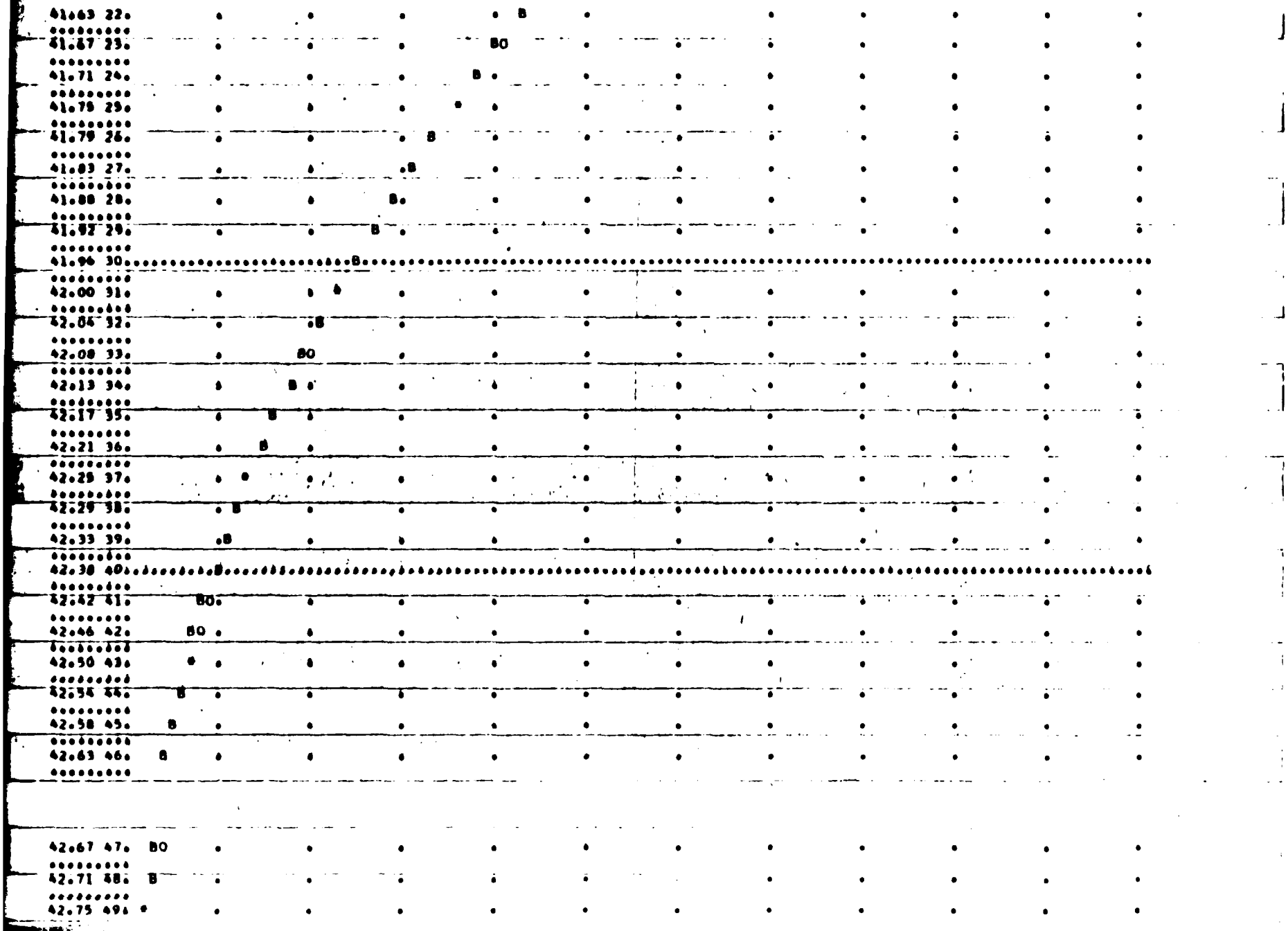
•OVF•

STATION 2

TIME (HRS) — (O) INTERPOLATED BREACH HYDROGRAPH (B) COMPUTED BREACH HYDROGRAPH — (*) POINTS AT NORMAL TIME INTERVAL

100. 200. 300. 400. 500. 600. 700. 800. 0. 0. 0. 0.

645.0.
40.75 1. B
645.0.
40.79 2. .B O
645.0.
40.83 3. B O
645.0.
40.88 4. O
645.0.
40.92 5. OB
645.0.
40.96 6. OB
645.0.
41.00 7.
645.0.
41.04 8. O B
645.0.
41.08 9. O B
645.0.
41.13 10. O B
41.17 11. O B
41.21 12. O B
41.25 13.
41.29 14. OB
41.33 15. O B
41.38 16. OB
41.42 17. OB
41.46 18. OB
41.50 19.
41.54 20. B
41.58 21. B


41.63 22.
41.67 23.
41.71 24.
41.75 25.
41.79 26.
41.83 27.
41.88 28.
41.92 29.
41.96 30.
42.00 31.
42.04 32.
42.08 33.
42.13 34.
42.17 35.
42.21 36.
42.25 37.
42.29 38.
42.33 39.
42.38 40.
42.42 41.
42.46 42.
42.50 43.
42.54 44.
42.58 45.
42.63 46.
42.67 47.
42.71 48.
42.75 49.

OVN

DAM BREACH DATA

BRWID	Z	ELBM	TFAIL	WSEL	FAILEL
30.	.50	1711.00	2.00	1744.00	1750.00

STATION 2. PLAN 2. RATIO 1

HYDROGRAPH ROUTING

CHANNEL ROUTING - MOD PULS REACH NO. 1

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
3	1	0	0	0	0	1	0	0

ALL PLANS HAVE SAME ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	0.	0

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.0600	.0500	.0600	1638.0	1660.0	800.	.00880

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC
0.00 1660.00 75.00 1650.00 150.00 1640.00 152.00 1638.00 154.00 1638.00
156.00 1640.00 300.00 1650.00 350.00 1660.00

STORAGE	0.00	.07	.20	.75	1.83	3.45	5.61	8.32	11.56
//1715.84									
	19.85	24.47	29.60	35.04	40.79	46.85	53.22	59.89	66.87
//1774.16									
OUTFLOW	0.00	8.01	33.56	124.69	353.07	776.21	1443.32	2398.84	3683.92
.45337.23									
	7395.47	10044.40	13220.88	16841.77	20915.58	25451.98	30461.46	35955.04	41944.13
.48440.36									
STAGE	1638.00	1639.16	1640.32	1641.47	1642.63	1643.79	1644.95	1646.11	1647.26
//1648.42									
	1649.58	1650.74	1651.89	1653.05	1654.21	1655.37	1656.53	1657.68	1658.84
//1660.00									
FLOW	0.00	8.01	33.56	124.69	353.07	776.21	1443.32	2398.84	3683.92
.45337.23									
	7395.47	10044.40	13220.88	16841.77	20915.58	25451.98	30461.46	35955.04	41944.13
.48440.36									

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIO 1
				.20
HYDROGRAPH AT	1	.29	1	165.
		(.75)		(4.66)
			2	165.
				(4.66)
ROUTED TO	2	.29	1	735.
		(.75)		(20.81)
			2	163.
				(4.61)
ROUTED TO	3	.29	1	757.
		(.75)		(21.44)
			2	163.

RATIOS APPLIED TO FLOWS

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 ••••••••••••••••

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1744.00	1744.00	1746.10
STORAGE	37.	37.	44.
OUTFLOW	0.	0.	95.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.20	1746.22	.12	44.	740.	.58	41.21	40.75

PLAN 2 ••••••••••••••••

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1744.00	1744.00	1746.10
STORAGE	37.	37.	44.
OUTFLOW	0.	0.	95.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.20	1746.22	.12	44.	163.	3.00	41.00	0.00

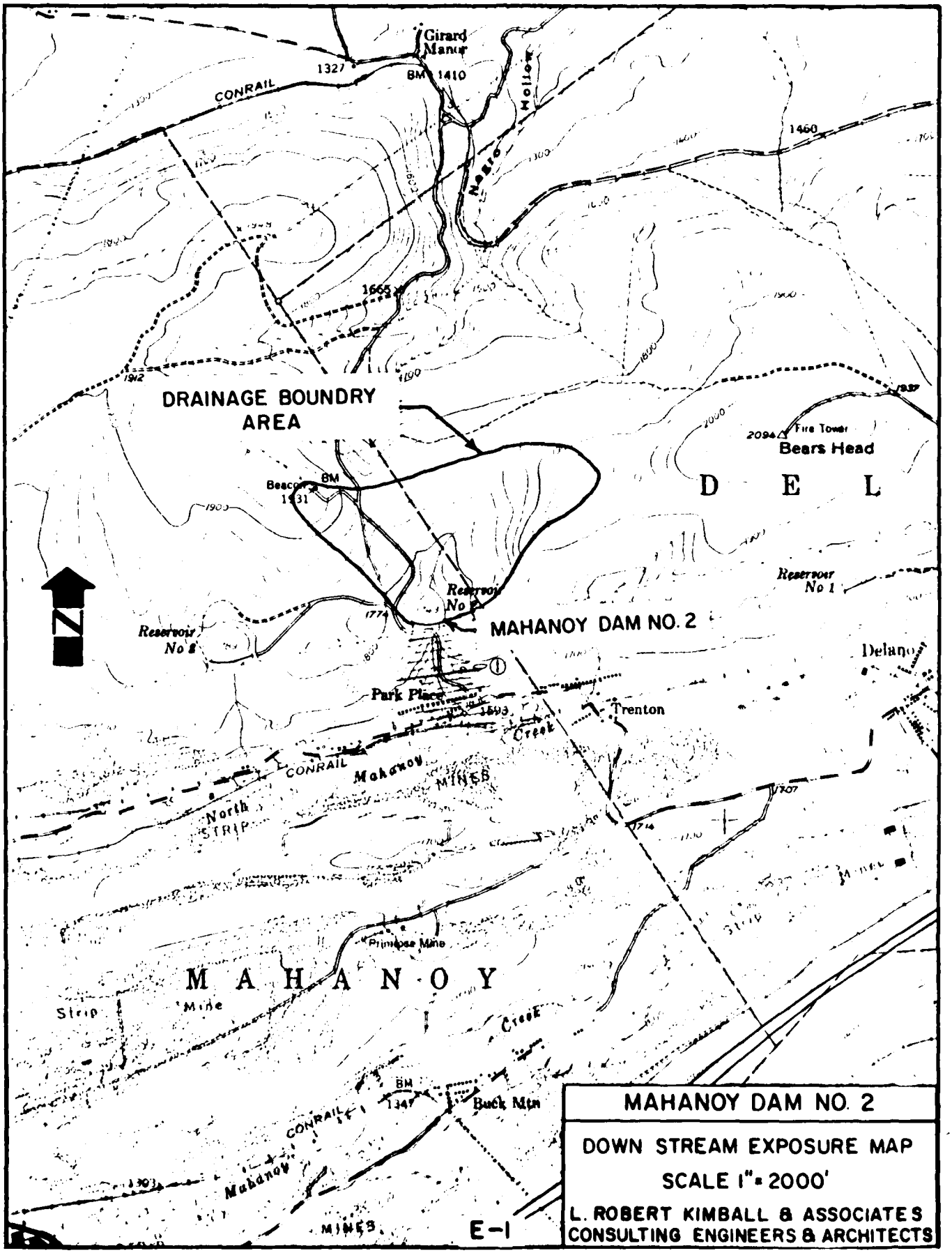
PLAN 1 STATION 3

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.20	757.	1643.7	41.25

PLAN 2 STATION 3

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.20	163.	1641.7	41.25

APPENDIX E
DRAWINGS



MAHANOY DAM NO. 2

DOWN STREAM EXPOSURE MAP

SCALE 1" = 2000'

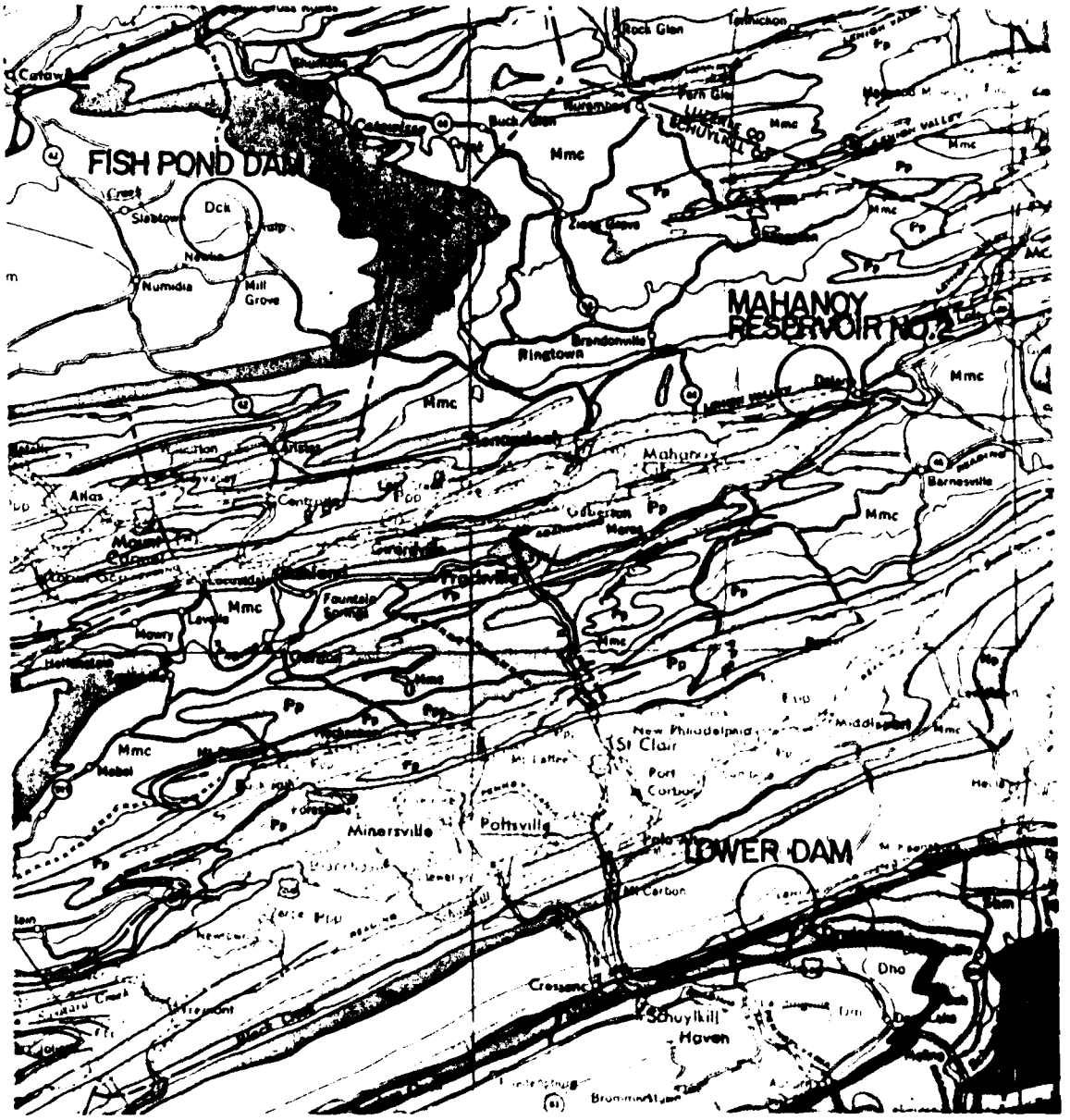
L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS & ARCHITECTS

APPENDIX F
GEOLOGY

General Geology

Mahanoy Dam No. 2 lies within the Appalachian Mountain Section of the Valley and Ridge Physiographic Province. This area is characterized by overturned and assymetric folds, local shearing, and large, low-angle thrust faults. Some faulting is indicated about one mile to the south and a few miles to the northeast of the reservoir.

The bedrock underlying the dam consists of the Pennsylvanian aged Pottsville Group. This group is formed primarily by conglomeratic sandstone, with lesser amounts of clay, coal, limestone, siltstone and shale. The usually well developed bedding ranges in thickness from a fraction of an inch in the shales to several feet for the sandstones. Jointing and fracturing is significant although variable depending on rock type. The weathering characteristics are also variable and depend upon rock type. The rocks generally form a good foundation for heavy structures when excavated to sound material, except for the clays which deform under pressure when wet.



GEOLOGICAL MAP OF THE AREA AROUND FISH POND DAM, LOWER DAM AND MAHANOY DAM NO. 2

Pp — Pottsville Group

SCALE 1 : 250,000

Mmc — Mauch Chunk Formation